NASA TECHNICAL MEMORANDUM

NASA TM-76033

DYNAMICS OF CHANGE OF LIPID AND MONOAMINE METABOLISMS AND THE BLOOD COAGULATION SYSTEM DURING EXPERIMENTAL ATHEROSCLEROSIS CAUSED BY RESTRICTION OF MOVEMENT

G. S. Gvishiani
and
N. G. Kobakhidze

Translation of "Lipiduri, monoaminuri da siskhlis shemdedebeli sistemis tsvlilebat'a dinamika modzraobis shezgudvit' gamotsveuli at'erosklerozis dros," Soobshcheniya Akademii Nauk Gruzinskoy SSR, Vol. 60, No. 2, 1970, pp 445-447

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
APRIL 1980

STANDARD TITLE PAGE

1. Report No. NASA TM-76033	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle DYNAMICS OF CHANGE OF LIPID AND MONOAMINE METABOLISM AND THE BLOOD COAGULATION SYSTEM DURING EXPERIMENTAL ATHEROSCLEROSIS CAUSED BY RESTRICTION...		5. Report Date April 1980 6. Performing Organization Code
7. Author(s) G. S. Gvishiani and N. G. Kobakhidze		8. Performing Organization Report No. 10. Work Unit No.
9. Performing Organization Name and Address Leo Kanner Associates Redwood City, California 94063		11. Contract or Grant No. NASW-3199 13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration, Washington, D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes
Translation of "Lipiduri, monoaminuri da siskhlis shemdedebeli sistemis tsvlilebat'a dinamika modzraobis shezgudvit' gamotsveuli at'erosklerozis dros," Soobshcheniya Akademii Nauk Gruzinskoy SSR, Vol. 60, No. 2, 1970, pp 445-447

16. Abstract
Shifts were studied in lipid, catecholamine, and blood coagulation systems following various periods (1, 2, 3, and 4 months) of experimentally-induced atherosclerosis. The same indices were studied in the tissues of the myocardium, liver, and brain stem-reticular formation after decapitation of the animals at the end of the experiment. Periodic motion restriction caused an increase in blood beta-lipoproteins in the rabbits at the beginning of the experiment. An increase in general cholesterol content and a decrease in the lecithin-cholesterol index were established at the end of the experiment. Myocardial beta-lipoprotein and brain stem reticular formation general cholesterol contents were elevated; catecholamine content was increased at the end of the experiment. In the initial months, free adrenaline basically increased, while in later months blood adrenaline decreased and blood noradrenaline increased.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22.
Unclassified	Unclassified	5	

DYNAMICS OF CHANGE OF LIPID AND MONOAMINE METABOLISMS AND THE BLOOD COAGULATION SYSTEM DURING EXPERIMENTAL ATHEROSCLEROSIS CAUSED BY RESTRICTION OF MOVEMENT

G. S. Gvishiani and N. G. Kobakhidze
Georgian SSR Academy of Sciences

Research was done on alterations of lipid, catecholamine, and blood /445* coagulation system dynamics during the total restriction of the motor activity of rabbits. Experiments were performed using 16 chinchilla rabbits which were accustomed to vivarium conditions. The rabbits were divided into 2 groups: the first (control) group consisted of 10 rabbits, the second (experimental) group -- 6 rabbits.

The animals of the experimental group were placed in special cages for motion restriction [1]. The rabbits were maintained under these conditions for 10 days. Next they were allowed to recover for 10 days, then were once again subjected to 10 days of motion restriction. This schedule continued for 4 months. After one month, blood was taken from the experimental group animals and the following were determined: 1) general cholesterol -- using Bloor's test, 2) lecithin -- using Bloor's micromethod, 3) beta-lipoproteins -- with Ledvina's method, 4) general coagulation -- using the Lee-White method, 5) prothrombin index -- using M. Machablis' modification of the Kudryashov-Quick method, and 6) catecholamines -- using modifications by A. Utevskiy and M. Butomis, and S. Zhislinas and N. Smazhnov, of the Schultze method.

We shall discuss shifts in catecholamine quantity according to specificity coefficients. Specificity coefficients (Sp.C.) represent the proportion of alkaline and acid compounds among adrenaline-like substances. When the Sp.C. is approximately >2, there is only free adrenaline in the blood, but when the Sp.C. is roughly between 1 and 2, the blood contains a mixture of adrenaline and similar substances.

If the Sp.C. is anything less, the blood has no free adrenaline.

---

*Numbers in the margin indicate pagination in the foreign text.

Following the conclusion of observations, both groups of rabbits were sacrificed by decapitation and some indices in various tissues (myocardium, liver, thalamus, and brain stem reticular formation) were recorded. Heart muscle and brain tissue catecholamines were determined using B. Manukhin's method. The results from the studies conflicted somewhat. Hence, we took into consideration only statistically reliable alterations.

Blood beta-lipoprotein content began to increase in the early period of the experiment and continued to do so until the end of the tests. In the initial stages it increased to 39.1 ± 3.5 mg%, but at the experiment's end it reached 220 ± 9.2 mg% ($P < 0.001$). During the first three months of the test, general cholesterol and lecithin-cholesterol content remained almost unchanged, but finally registered some alteration by the experiment's end: general cholesterol was initially approximately /446 73.6 ± 3.5 mg%, and lecithin-cholesterol equaled 2.1 ± 0.07. In the experimental rabbits, general cholesterol was 123.7 ± 8.6 mg% ($P < 0.001$) and the lecithin-cholesterol index decreased to 1.3 ± 0.05 ($P < 0.001$).

Indications of changes in the liver were insignificant. Increases were noted in myocardial beta-lipoproteins ($P < 0.001$) and reticular formation general cholesterol ($P < 0.05$), while cholesterol ($P < 0.01$) and beta-lipoprotein ($P < 0.001$) quantities in the thalamus increased and the lecithin-cholesterol index decreased ($P < 0.01$).

Blood catecholamines increased beginning with the first day of the experiment. Given that the normal specificity coefficient was measured as 0.93 ± 0.2 (i.e., < 1), in the first month it grew most precipitously ($P < 0.001$), equaling 2.07 ± 0.15 (Sp.C. > 2); blood adrenaline-like substances then increased and free adrenaline was dispersed. In the second and third months, the Sp.C. was > 1 and < 2. This number indicates a mixture of free adrenaline and other adrenaline-like substances.

It appeared that free adrenaline quantities decreased as the experiment lengthened. At the conclusion of the experiment (after 4 months) the Sp.C. < 1 -- specifically, it equaled 0.87 ± 0.22. There was decreased

blood noradrenaline during this period. Changes in catecholamine content in various organs was well demonstrated. A statistically reliable reduction was noted in myocardial noradrenaline ($P < 0.05$); alterations in adrenaline quantity were, however, statistically quite unreliable ($P < 0.5$). In the liver ($P < 0.5$) and thalamus ($P < 0.01$), adrenaline quantity reliably increased, while noradrenaline did not. A contrary balance was seen in the brain stem reticular formation -- adrenaline decreased ($P > 0.5$) and noradrenaline increased somewhat ($P < 0.001$).

From the beginning of the experiment, blood coagulation demonstrated distinct changes; the general blood coagulation rate and the prothrombin concentration increased. The blood coagulation index initially averaged 485.29 ± 29.2 and the prothrombin index $87.7 \pm 1.5\%$, but coagulation time averaged 137.5 ± 14.0 minutes less ($P < 0.001$) than the original value at the conclusion of the experiment.

The obtained results are of considerable interest, but we shall now focus our attention on changes in catecholamine content in the respective organs and the blood. Catecholamine content in the blood definitely increased during the total restriction of the rabbits' movements.

Discussed in terms of specificity coefficients, the catecholamine fraction did not increase regularly. Free adrenaline basically increased during the first month, but, on the other hand, blood free adrenaline diminished in the following month while noradrenaline content increased.

With regard to myocardial catecholamine content, we observed that noradrenaline content showed a decrease in the final period (after 4 months). Adrenaline quantity, however, remained unchanged. The fact that blood noradrenaline content was elevated and myocardial content was /447 reduced at the end of the experiment may be explained by a reduction in myocardial catecholamine absorption.